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FORECAST RESEARCH ON 1969 KODIAK AREA PINK SALMON RETURN

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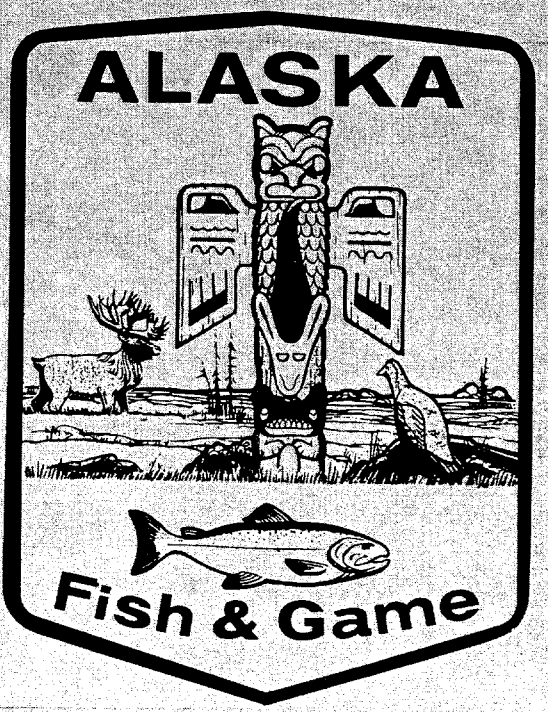

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INTRODUCTION

This is the fourth annual published forecast of the pink salmon return to the Kodiak area. Forecasts are based primarily on the relative abundance of pre-emergent fry. The term "relative" is used since an estimate of total fry abundance is not obtained, instead an estimate of live pink salmon fry per unit area is obtained from the pre-emergent fry sampling. The index of fry abundance is, therefore, fry per unit area, and it is assumed that this index of fry abundance is directly proportional to the total number of live fry in the gravel of the stream at the time sampling is conducted.

In addition to pre-emergent fry data, annual environmental conditions and the relationship of parent escapements to subsequent returns are used to arrive at a forecast. Consideration of all factors is necessary, especially in view of the limited pre-emergent fry data.

Past forecasts and estimated total returns for 1966-68, are listed in Table 1. In overall evaluation, the forecasts for the past three years have been within usable limits. The 1967 return was forecast as an overall failure, and it was stated in the published report that the return was likely to fall in the lower range of the forecast, i.e. approximately two million fish. In addition, the commercial fishery was sharply curtailed in 1967 to allow most of the returning pink salmon to enter the streams and spawn. Therefore, the estimated 1967 total return (catch plus escapement) was based primarily on aerial escape-

1/ This investigation was partially financed by the Commercial Fisheries Research and Development Act (P.L. 88-309) under Project 5-4-R-6, Contract Number 14-17-0005-169.

ment estimates, which are often highly variable estimates of total spawner abundance. Hence, the estimated total return for 1967 is given as a range rather than as a single number. In 1966 and 1968 the escapements comprised between 11 and 19 percent of the total return so that inherent errors in escapement estimates were not as significant relative to the total return estimate as in 1967.

Table 1. Pink Salmon Forecasts and Estimated Total Returns, 1966 - 1968.

Year	Millions of Pink Salmon Forecasted Return	Estimated Total Return
1966	10.94	11.50
1967	2 to 4 (3.00 Mean)	1.70 to 1.20
1968	9.44	9.56

The real benefits of annual forecasts are difficult to measure quantitatively, but are manifold to the industry. Normally the total forecasted return is apportioned, on the basis of relative fry abundance, to the major fishing districts, and any particular stream or major area with expected strong or, alternatively, weak forecasted returns are identified. This type of information allows a more complete and orderly harvest of the runs and is consistent with the principles of commercial fisheries management.

CLIMATOLOGY

Each year the Kodiak area forecast report has included a brief resume of the overwinter climatic conditions that could affect fry survival. It is extremely difficult to determine, with any degree of confidence, the quantitative effect of climatic conditions on the survival of pink salmon eggs and fry in freshwater. Unusual or drastic fluctuations in climatic patterns, may to a large extent, account for large annual fluctuations in the number of pink salmon fry surviving to enter the sea, which in turn determines to a great extent the number of returning adults.

From Figure 1 it can be seen that during 1967-68 the average monthly temperatures tended to follow the 17-year averages. Although the precipitation during several months in 1967 deviated significantly from past averages, field observations indicated that this did not adversely affect fry survival. Stream

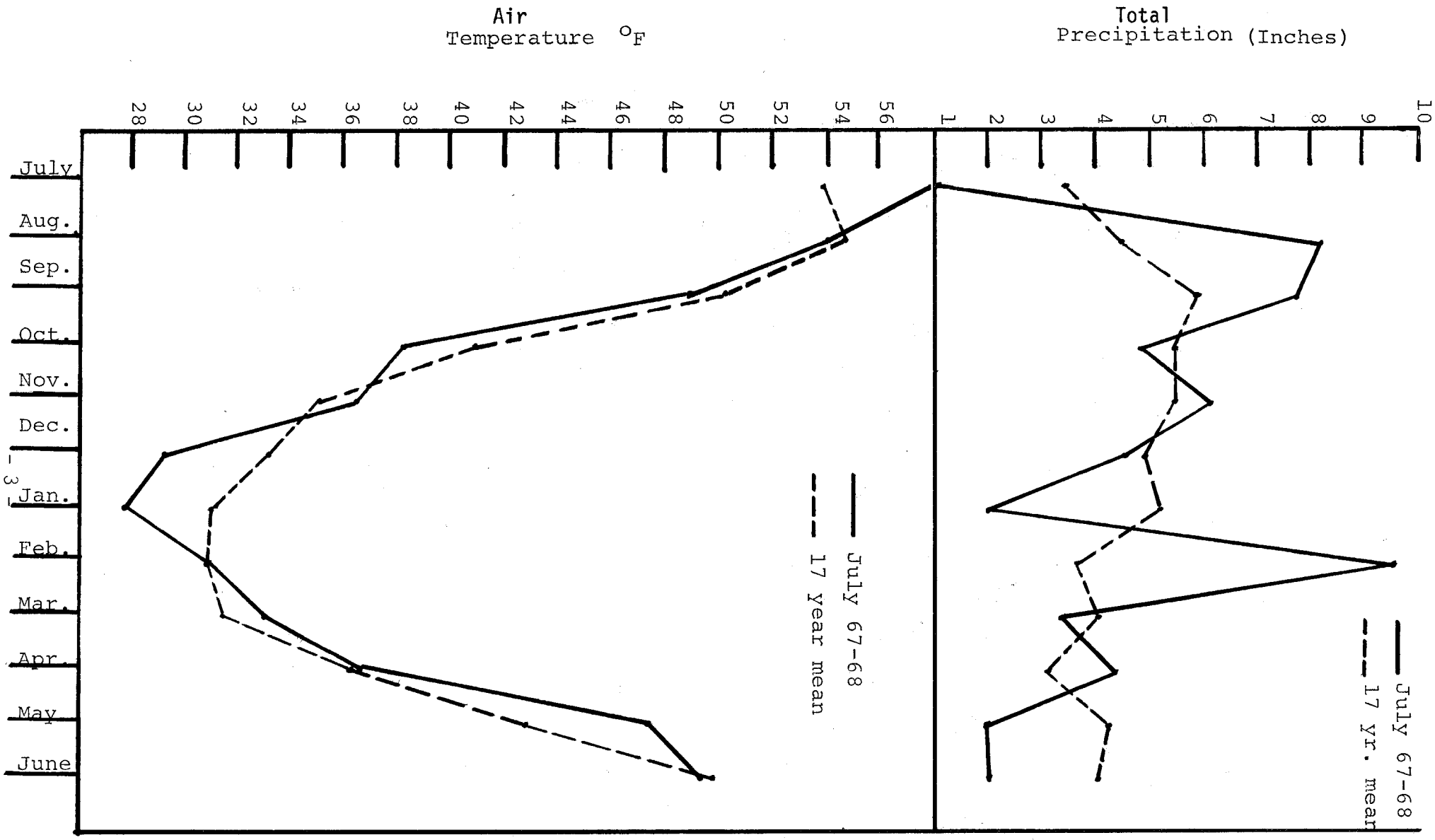


Figure 1. -- Monthly temperature and precipitation levels for July 1967 through June 1968 as compared to the seventeen-year mean.

flows during late August and early September were slightly above average, but visual field observations indicated that flows were good throughout the critical spawning period. Considerable precipitation also occurred during January and early February in the form of rainfall at lower elevations, but aerial surveys revealed no serious flooding. Additionally, the snow pack and ice formation was light due to the mild winter temperatures which prevailed. In general, 1967-68 overwinter climatic conditions would be considered favorable to freshwater survival.

ANALYSIS OF ESCAPEMENT-RETURN DATA

The relationship between parent escapements and corresponding returns is highly variable and the data can only in very broad terms provide an insight as to the probable magnitude of the return. Inherent errors which are at present unavoidable in an escapement to return analysis are:

1. Escapements are based on aerial counts of spawning pink salmon and as such are necessarily subject to various margins of error. Counts vary from day to day, between observers, and with visual conditions.

2. No information concerning spawning distributions have been included in the escapement records. Spawning distribution within streams varies tremendously from year to year and this affects the productivity of a stream.

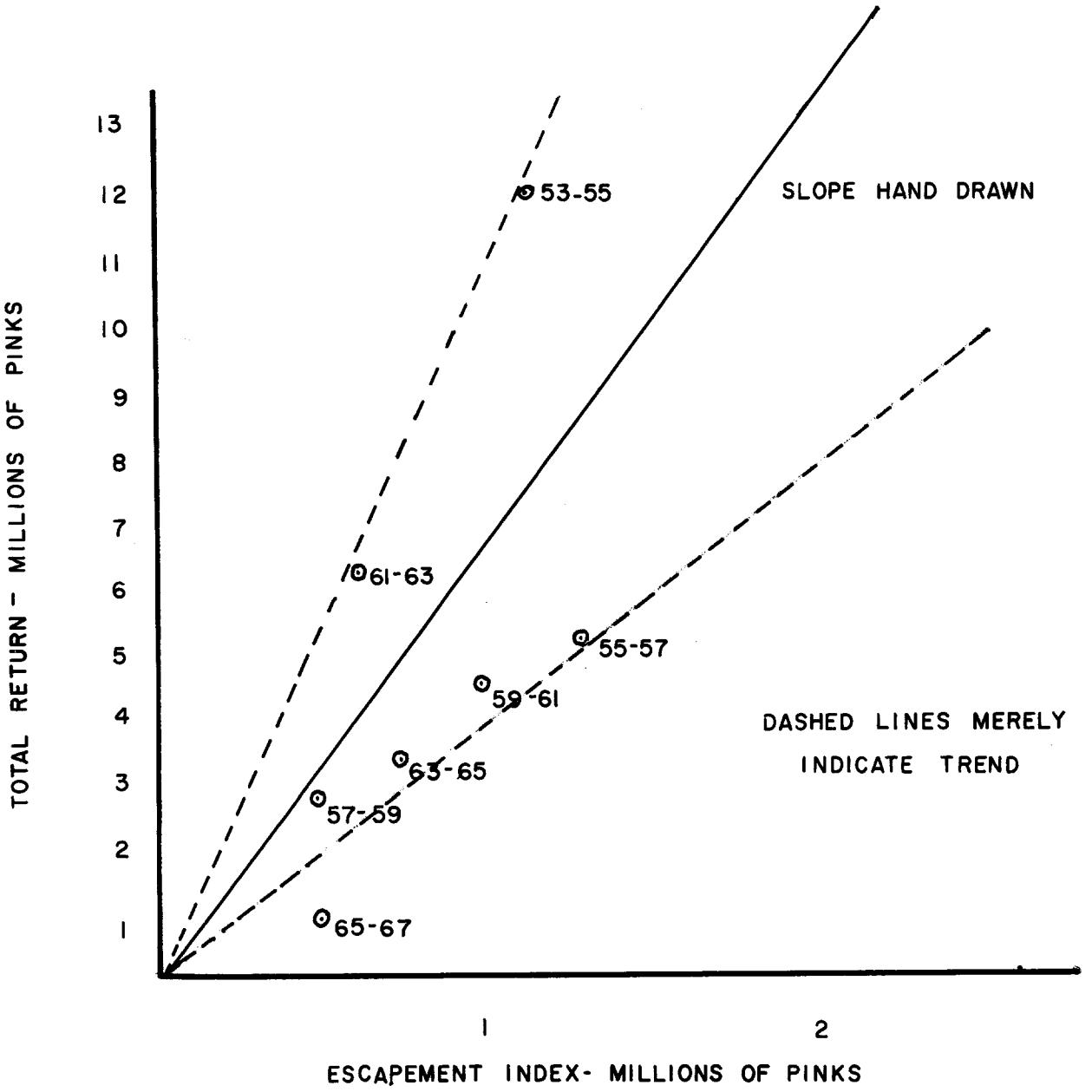
3. Last, but perhaps most important, the effect of varying climatic conditions from year to year are not utilized in the present escapement to return analysis.

Considering the foregoing factors, it may be seen from Figure 2 that as escapements increase, the resulting return also tends to increase. Table 2 shows the total returns for the odd years 1955-67 and Figure 3 presents a graphic representation of the odd year total returns.

Escapements in 1967 were low (0.5 to 1.0 million estimated). Based on the escapement to return relationship (Figure 2) the return in 1967 would fall between 3 and 6 million pinks. However, it must be pointed out that similar escapements as those which occurred in 1967, have resulted in returns much larger than 6 million. For example, in 1953 the escapement was only slightly over a million pink salmon, but the return in 1955 was in excess of 12 million pinks. Although escapement records for the Kodiak area do not exist prior to

FIGURE 2

KODIAK-AFOGNAK ISLAND AREA PINK SALMON ESCAPEMENT TO RETURN RELATIONSHIP ODD YEARS 1953 TO 1967. POINTS REPRESENT BROOD YEAR/YEAR OF RETURNS.



65-67 omitted as an outlyer

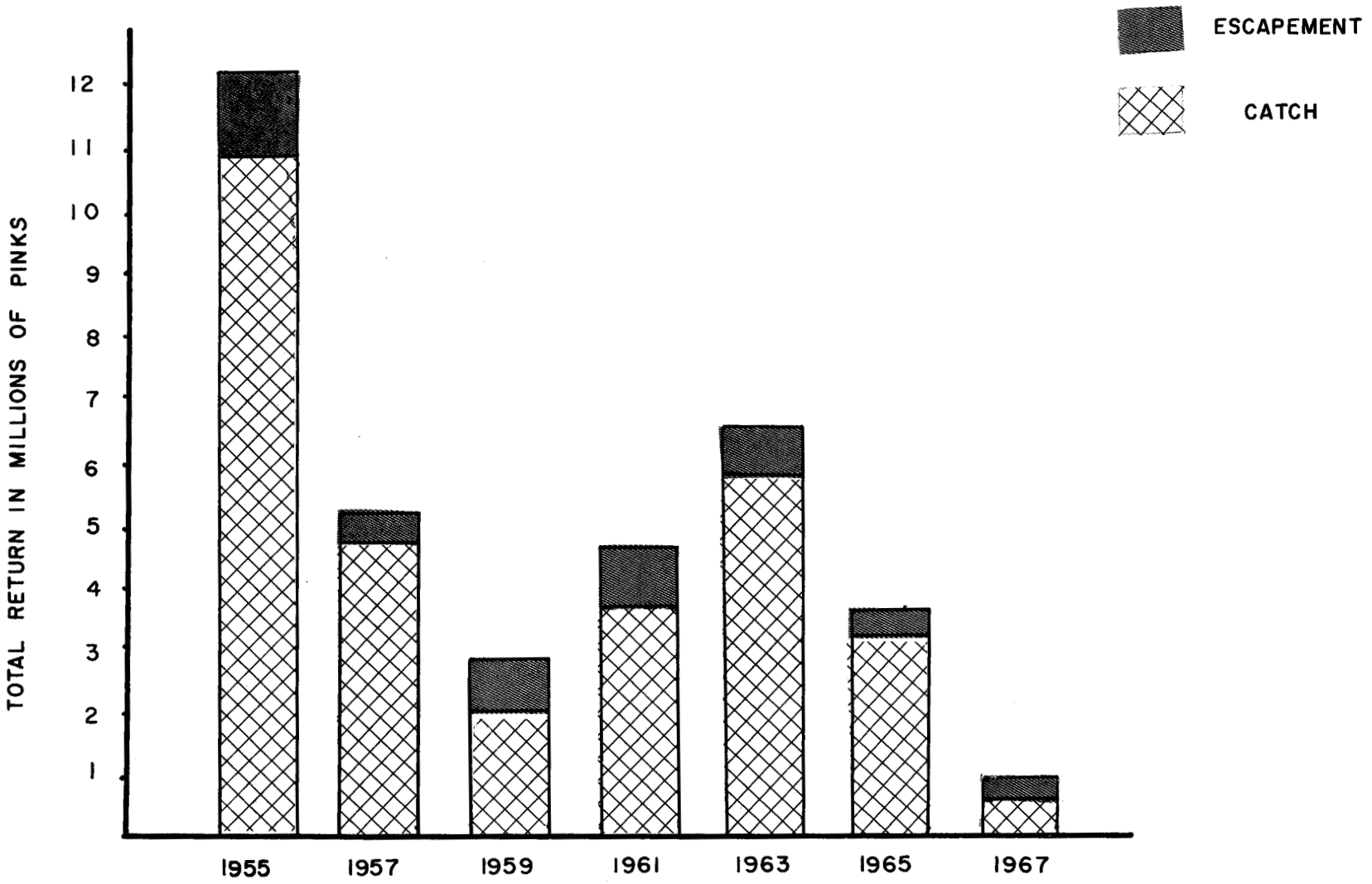
Table 2. Kodiak Island Area Pink Salmon Returns for the Odd Years 1955-1967.

Year	Millions of Salmon		
	Catch	Escapement [1]	Total Return
1955	10.79	1.28	12.07
1957	4.69	.47	5.16
1959	1.80	.98	2.78
1961	3.93	.61	4.54
1963	5.48	.74	6.22
1965	2.89	.50	3.39
1967	0.20	0.50 to 1.0	0.70 to 1.2

1/ Aerial escapement surveys are based on work conducted by Fisheries Research Institute, University of Washington. With the exception of one season, all escapement counts have been made by Dr. Donald E. Bevan of F. R. I. Catch statistics are from Alaska Department of Fish and Game Statistical Leaflets and/or Kodiak Annual Reports of the Alaska Department of Fish and Game.

FIGURE 3

TOTAL RETURN OF PINK SALMON TO THE KODIAK ISLAND AREA FOR THE ODD-YEAR CYCLE 1955 TO 1967. DATA ARE FROM FRI AERIAL SURVEYS AND FROM ADF&G CATCH STATISTICS.



1951, the 61/63 and 53/55 points shown on Figure 2 cannot be considered unique. From 1925 through 1947 the odd-year production of pink salmon in the Kodiak Island area exceeded even year productions by a considerable margin. (Average case pack odd-years 1925-1947 equaled 460,000 cases annually; average case pack even-years 1926-1948 equaled 325,000 cases). Since dependable escapement records do not exist prior to 1951 it is not possible to plot these data on Figure 2, but it is reasonable to assume that many, if not all of these points, if known, would fall along the upper trend line. Odd year production since 1949, has decreased considerably relative to prior years (averaging about 200,000 cases vs 460,000 cases) thus giving an unrealistic view in Figure 2. Despite the reduced level or production in recent years, it is the author's opinion that as a result of favorable survival conditions during the freshwater stage of the life cycle, the rate of production from the 1967 escapement will fall in the range occurring in the years prior to 1949.

Furthermore, it is felt that the above assumption is justified and that on the basis of the escapement - return data, with consideration to all other factors which have a bearing on the 1969 forecast, the return will in fact fall along the upper trend line of Figure 2. If true, this would indicate a return in 1969 of between 6 and 10 million pink salmon.

ANALYSIS OF PRE-EMERGENT FRY DATA

Analysis of pre-emergent fry data for the 1969 cycle has proven very difficult. Prior to 1967, no odd-year pre-emergent data exists. Data from the 1965 cycle was lost as a result of the earthquake in the spring of 1964. With data for only a single odd-year cycle and the fact that odd and even-year data are probably not directly comparable without some weighting procedure, it is not possible to forecast the 1969 return with the same degree of reliability that has been possible for the dominant even-year cycles of the Kodiak Island area.

There appears to be methods by which the odd and even-year data may be weighted in order to make the data comparable, however, these procedures are unproven and will remain so until a longer history of odd-year data has been collected.

Experimental weighting procedures have been applied to the data which currently exists and these methods give indications that the return in 1969 will be stronger than the values indicated by the escapement - return relationship (Figure 2). For example, an attempt was made to utilize the pre-emergent fry

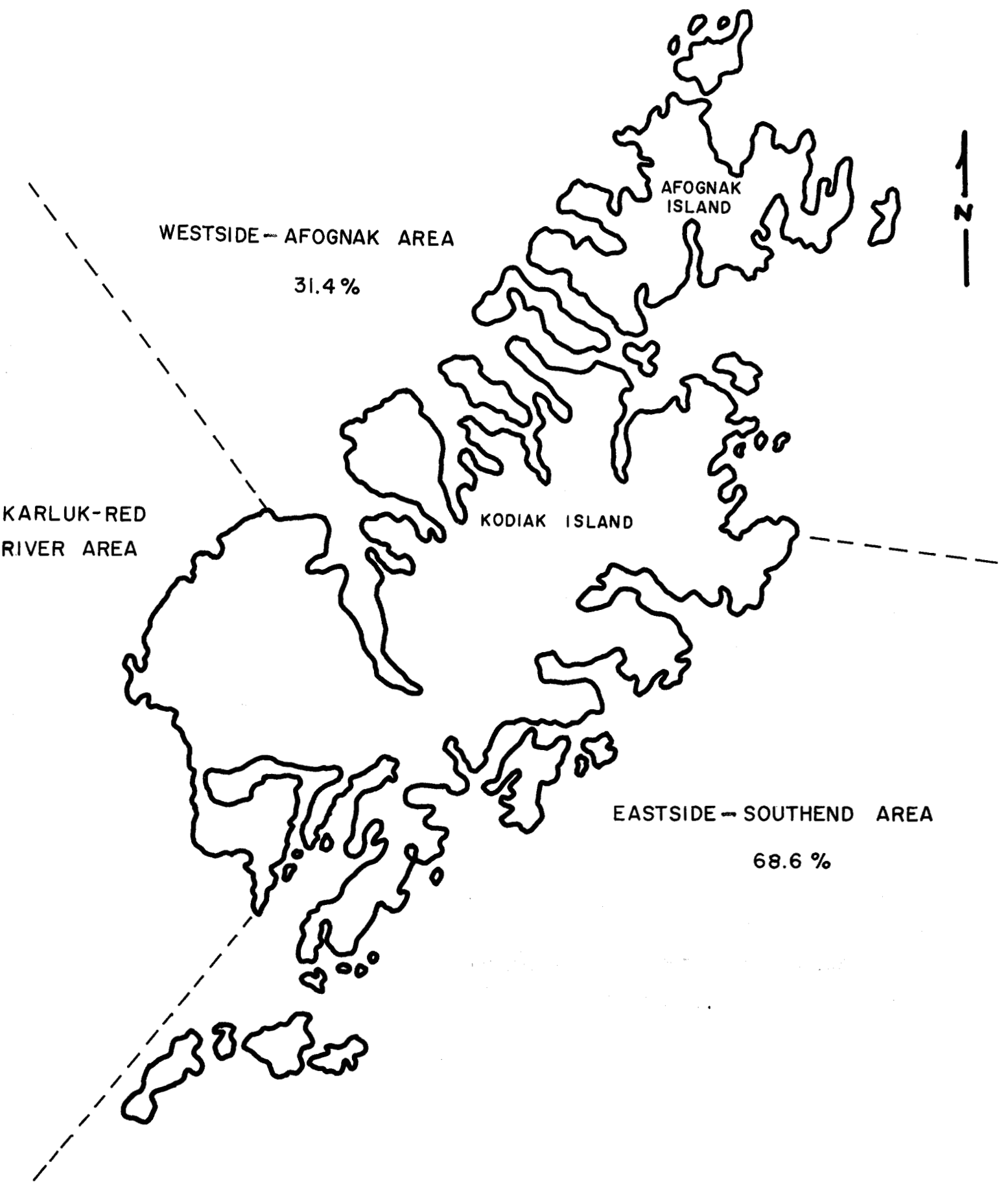
data as an indicator or index of yearly total fry production for those streams sampled each year. To arrive at total fry production values for the streams that were sampled, the pre-emergent fry density per square meter was multiplied by the available square meters of spawning area for each individual stream, which were then added together. It must be emphasized that total fry production for those streams sampled for pre-emergent fry, does not represent the total production of fry for all of the Kodiak-Afognak area. Rather, it is simply another and hopefully more meaningful, method of expressing sampling results, and remains an index of the overall production.

Measurements of available spawning area are estimates and one must make the assumption that pre-emergent fry densities found within the sampling areas are representative of the stream as a whole. Utilizing this method it has been determined that ocean survival of pink salmon returning to the Kodiak area has tended to be fairly constant which has allowed the runs to be forecast. The actual data and computations concerning total fry production for the sampled streams is not included with this report since they are both lengthy and are still in the developmental stage. It may be stated, however, that graphing this data for 1964 through 1969, resulted in an indicated return, which again exceeded that given by the escapement - return data. This further adds to the contention of the authors that the return in 1969 will fall between 7 and 10 million pinks.

ESTIMATED PINK SALMON RETURN BY DISTRICT

Even though it has proven very difficult to arrive at a definite numerical forecast for the 1969 return, it is possible to identify, quite clearly, those areas of expected weak or strong returns. In order to accomplish this, the Kodiak-Afognak Island area has been broken down into three major odd-year fishing districts, the Eastside-Southend area, the Westside-Afognak Island area and the Karluk-Red River area (Figure 4). The latter area is of little significance regarding pink salmon production, as only minor production occurs in that area on the odd-year cycle. The breakdown for the other two areas is based on relative pre-emergent fry densities. The method utilized to accomplish this breakdown is identical to that which has been employed for the past three years. Basically this consists of taking the mean pre-emergent fry density for each of the major fishing districts and converting them to a percent of the expected return (Table 3).

It is well to point out here, that although the numbers of fish returning to a particular district may change, the percent of the total return returning to that district, should not change significantly. In order to clarify the above statement, it may be stated that the Eastside-Southend area should receive



ESTIMATED PERCENT OF THE TOTAL RETURN OF PINK SALMON BY MAJOR DISTRICT TO THE KODIAK-AFOGNAK ISLAND AREA IN 1969.

FIGURE 4

Table 3. District estimates of run strength.

Westside-Afognak			Southend-Eastside		
		District			
Stream	Pre-emergent Fry index/.1 m^2	Percent	Stream	Pre-emergent Fry index/ .1 m^2	Percent
Afognak R.	0.00		Barling R.	1.33	
Danger R.	15.74		Kaiugnak R.	90.80	
Sharatin R. (Elbow)	6.74		Seven R. (Upstream)	37.49	
	22.48	4.7	Seven R. (Downstream)	41.73	
				171.35	36.1
Perenosa R. (Portage)	36.28		Humpy R. (Upstream)	9.06	
Paramanof R.	0.00		Humpy R. (Downstream)	56.76	
	36.28	7.6	Deadman R.	40.31	
			Dog Salmon R.	22.51	
Buskin R.	1.15		Narrows R.	25.45	
American R.	8.54			154.09	32.5
Sid Old's R.	10.16				
Saltery R.	7.71	5.8	Total percent of the 1969 run expected to return to the Southend-Eastside area.		68.6
	22.56				
Baumans R.	35.35				
Terror R.	0.41				
Uganik R.	9.63				
	45.39	9.6			
Zachar R.	0.00				
Uyak R.	17.51				
	17.51	3.7			
Total percent of the 1969 run expected to return to the Westside-Afognak area.		31.4			

approximately 69 percent of all returning pinks in 1969, regardless of the size of the total return to the islands, and the Westside-Afognak area should not receive more than 31 percent of the total return.

A certain degree of variation will occur in district forecasts. This is due to the fact that many times early stocks of fish utilize common migration routes, resulting in fish destined for one district being caught in a neighboring district. Also weather conditions, tides, shifting of the commercial effort, etc., all have a direct bearing on the assignment of catch to districts and therefore, on comparisons of district forecasts to actual returns. In 1969 this effect will probably be minimal because only major district classifications are made.

In addition to forecasts by major districts, it is important to have an idea of the contributions which can be expected from the individual streams. To accomplish this, the pre-emergent fry index for each stream is weighted by a percentage of the total parent escapement (Table 4). The resulting weighted index does not necessarily imply that a particular stream will or will not have a large or small return in relation to the total return. It will be meaningful only in relation to the productive potential of the particular stream in question. From Table 4 and Figure 5, it can be seen that those streams comprising the Westside-Afognak area, with the exception of Uganik and Uyak Rivers, are generally poor or failing, and that those streams comprising the Southend-Eastside area are generally good to excellent. This further substantiates the contention that the dominant returns in 1969 will occur in the Eastside-Southend areas. It may also be pointed out that Uyak and Uganik Rivers should produce good returns, but that Afognak, Zachar and Paramanof Rivers will fail, and that Terror, Barling and Buskin Rivers can be expected to produce only minor returns, less than desirable escapement levels. The following streams and/or areas produce few if any pink salmon on the odd-year cycle: Malina, Marka, Afognak (Litnik), Little, Brown's, Karluk, Sturgeon, Red and Portage River in Uyak Bay. All the above streams are primary producers on the even-year cycle. There are no streams which produce only on the odd-years in the Kodiak area. This further adds to the difficulties of comparing odd and even-year cycles.

MAINLAND DISTRICT FORECAST

The return to the mainland district in 1967 was extremely light. Escapements were estimated at only 38,000 pinks and the catch was less than 1,000. Pre-emergent sampling does not take place in the mainland area, due to its distance from Kodiak, weather, rough terrain, cost of operation, etc. We may however, obtain a general idea of what can be expected by

Table 4. Kodiak-Afognak Island streams in order of weighted index.

Stream	Parent escapement	Percentage of total escapement	Fry index/ .1 m^2	Weighted index
Afognak R.	1,000	0.21	0.00	0.00
Zachar R.	2,700	0.58	0.00	0.00
Paramanof R.	200	0.05	0.00	0.00
Terror R.	35,000	7.49	0.41	3.07
Barling R.	12,000	2.57	1.33	3.42
Buskin R.	28,000 1/	6.00	1.15	6.90
Sharatin R.	11,000	2.35	6.74	15.84
Danger R.	5,000	1.07	15.74	16.84
Perenosa R. (Portage)	3,000	0.64	36.28	23.22
American R.	14,000	3.00	8.54	25.62
Humpy R. (Upstream)	15,000	3.21	9.06	29.08
Bauman's R.	4,200	0.90	35.35	31.82
Narrows C.	7,000 1/	1.50	22.51	33.77
Sid Old's R.	19,000	4.07	10.61	41.35
Saltery R.	36,000	7.71	7.62	58.75
Dog Salmon R.	11,000	2.35	25.45	59.81
Seven R. (Upstream)	10,000	2.14	37.49	80.23
Uganik R.	40,000	8.56	9.63	82.43
Seven R. (Downstream)	15,000	3.21	41.73	133.95
Kaiugnak R.	8,000	1.71	90.80	155.29
Uyak R.	75,000	16.06	17.51	281.21
Humpy R. (Downstream)	45,000	9.63	56.76	546.60
Deadman R.	70,000	14.99	40.31	604.25

1/ ADF&G aerial surveys; all others conducted by F.R.I.

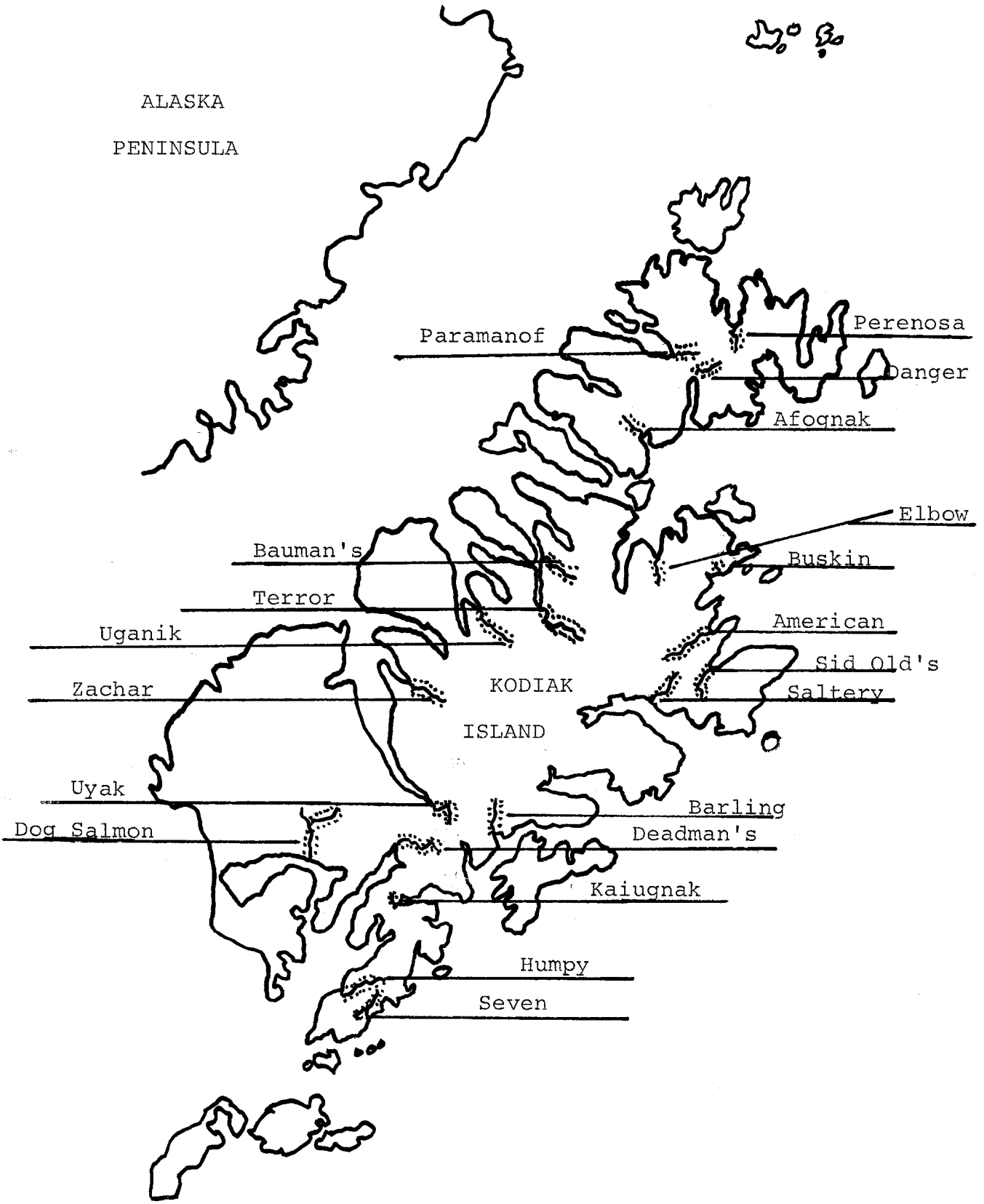


Figure 5. -- Map of Kodiak area showing the important odd-year pink salmon streams.

analysis of the escapement to return relationship. Information on the mainland area quite clearly demonstrates that there is a definite odd-even-year cycle trend in this area; the even years are dominant. Table 5 depicts the catch, estimated parent escapement and total return for odd years since 1959:

Table 5. Mainland area catch, escapement, total return 1959-67.

Year	Catch	Escapement	Matched Total Return
1959	27,054	15,500	57,000
1961	34,101	23,000	178,000
1963	4,706	173,000	118,000
1965	64,872	52,680 1/	39,000
1967	940	38,000	1969 return?

1/ ADF&G stream survey, all others by F.R.I.

Based on the above table, the upper limit of the return should not exceed 100,000 pinks in 1969, and it may well fall short of this figure.

DISCUSSION

It should be apparent to the reader that the only data-supported comparison which was available for use in arriving at a forecast for the 1969 pink salmon return to the Kodiak-Afognak Islands complex, was the escapement - return relationship. Even this relationship needs qualification and by itself is not a good indicator of total returns, because of large variations which occur in the total returns from similar escapement levels. Escapements prior to 1951 were not tabulated numerically, which prohibited their use in conjunction with the escapement to return data. Could they be used, there is little doubt but that they would strengthen the relationship considerably, since the odd-year production from 1927 through 1947 exceeded even-year production.

The authors conclude, with consideration to all factors which have a bearing on the escapement - return relationship that the return in 1969 is most likely to fall along the upper trend line of Figure 2, or between 6 and 10 million pinks.

Odd and even-year data is not considered directly comparable and until

a method of weighting the data is proven, this will remain true. Experimental weighting procedures, i.e., computing total fry production for those streams sampled each year since inseption of the pre-emergent program, and weighting parent escapement for odd and even-year cycles, give indication that the return in 1969 will fall between 7 and 10 million which adds further support to the conclusions drawn from the escapement - return data.

One can draw no exact conclusions from the climatic data except to say that brief analysis of the data (both observed and recorded) tends to indicate that climatic conditions necessary for surfival of the spawning run of 1967 from egg to fry were at least normal, and possibly above average.

Based on all the information available, it is the opinion of the authors that the return in 1969 to the Kodiak Island complex will fall between 7 and 10 million pink salmon, or a mean return of 8.5 million. We believe the majority of evidence available strongly indicates that this range of return is the most reasonable. We do not completely overrule the possibility that the return will fall short of the 7 million figure, nor that it may exceed the 10 million figure, but only that this is unlikely in consideration to all other factors involved.

Regardless of run strength in 1969, approximately 69 percent of all pinks returning to the Kodiak-Afognak area should appear in the Eastside-Southend area, and 31 percent to the Westside area. Only very insignificant runs of pink salmon occur in the Karluk-Red River area on odd-year cycles.

Finally, it is a known fact that the mainland area has been notably lacking in pink salmon production on the odd-years. Extremely low parent escapements occurred in 1967, so that even if ideal survival conditions prevailed, only a small return can be expected in 1969 to that area.

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